WETLANDS

OF THE

CATTAI CATCHMENT

Summary Report

Hawkesbury Nepean
CATCHMENT MANAGEMENT TRUST

Cattai Catchment Management Committee

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CATCHMENT MANAGEMENT COMMITTEE

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January 1998

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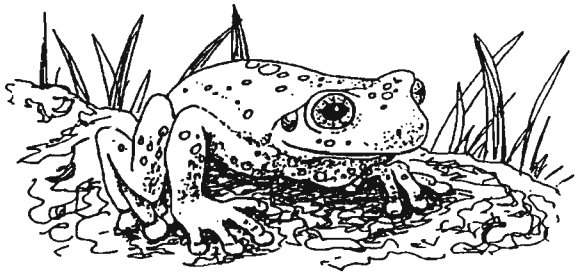

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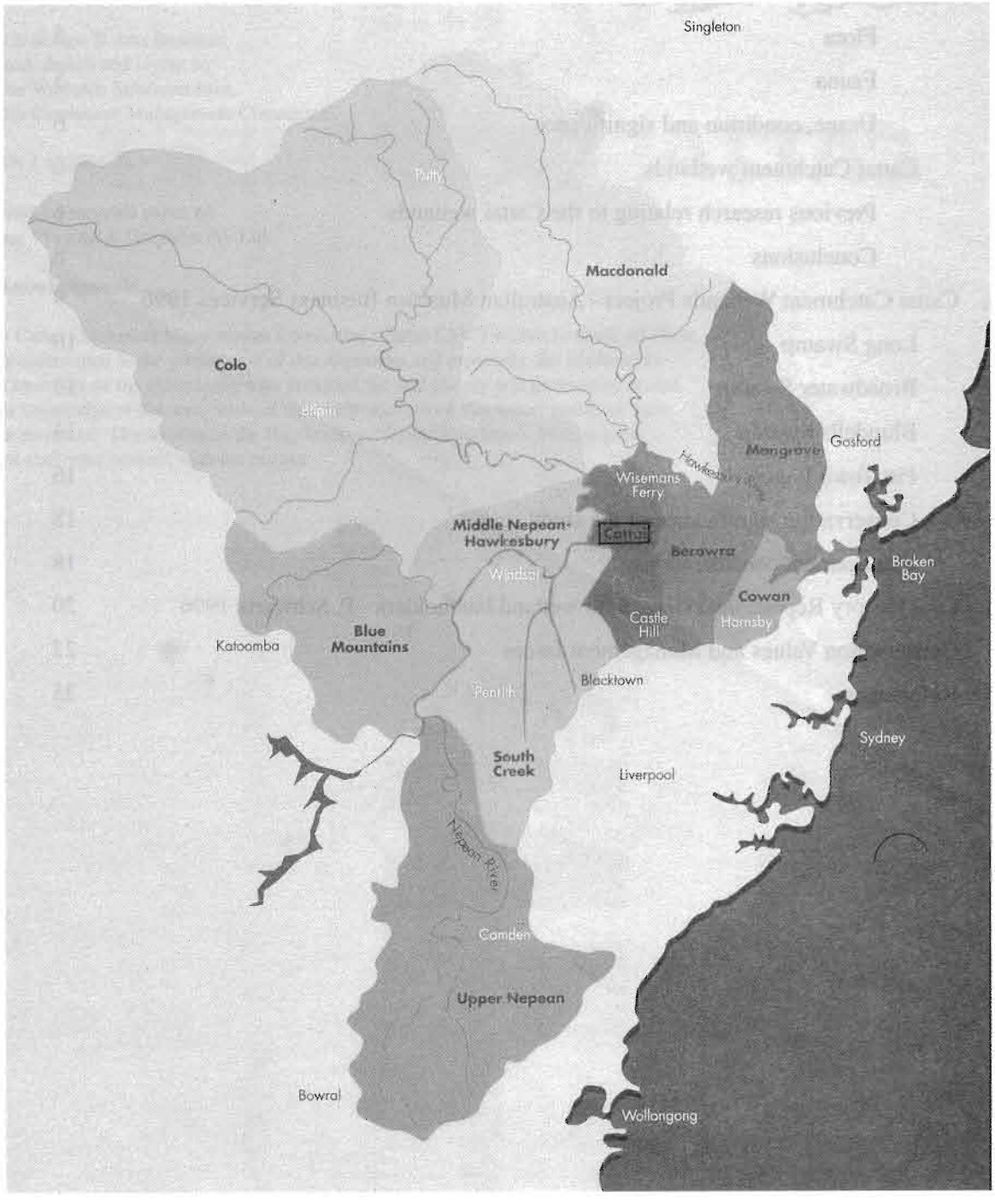


Figure 1. Catchment Management Areas in the Hawkesbury-Nepean Trust Area

1 Introduction

The Cattai Catchment Management Committee (Cattai CMC) was established in July 1994 to bring members of the community, local Government and State Government agencies together to identify and develop solutions to problems within the Cattai Catchment. The CMC aims to bring together people from a range of backgrounds and interests with a variety of skills and knowledge to help make the Cattai Catchment a better place for people to live and work, and for future generations to enjoy. The Committee members include representatives from Baulkham Hills Shire Council, various State Government Departments, environment groups and the community. The Cattai CMC is funded through the Hawkesbury-Nepean Catchment Management Trust.

The Cattai CMC undertook the Cattai Wetlands Project in order to:

- collate and evaluate existing information on the Cattai Catchment's wetland areas of local, regioal, state and national significance, and to use this to consider other wetlands in the catchment area;
- develop a plan outlining general principles and policies for wetland management;
- develop site specific management guidelines for each wetland;
- assist landholders and the community in protecting and conserving wetlands and in understanding their value; and
- make recommendations to appropriate authorities to improve planning and management practices for wetland areas.

The first of three phases of the project was completed with the finalisation of three reports:

1. Latham, H. 1996. *Literature Review of Cattai Wetlands*. Unpublished Report to the Cattai Catchment Management Committee.
2. Australian Museum Business Services. 1996. *Cattai Catchment Wetlands Project*. Unpublished Report to the Cattai Catchment Management Committee.
3. Schwartz, P. 1996. *Oral History Report:* Interviews with wetland landholders. Unpublished Report to the Cattai Catchment Management Committee.

The next phase of the Cattai Catchment Wetlands Project will involve raising community awareness of the importance of these wetlands and the ways in which the community can help protect them. In addition to the summary report a series of brochures on four individual wetlands from within the Cattai Catchment will be produced.

The third phase will be to increase the protection and conservation of the identified wetlands through the development of management plans with the community and stakeholders.

This report presents a summary of the findings of the three reports. Copies of the full reports are held by Cattai CMC and the HNCMT. Contact the Cattai CMC Coordinator on (02) 9651 2170 for more information.

Wetlands mapped for Draft REP 20, 1994

Fig. 1 Reference	Wetland/Site	1:25000 map ref.
88	Jackson's Swamp. Sth. Lower Half Moon Bend	LPO 3106 - 62985
89	Sth. Upper Half Moon Bend, near Cliftonville Gardens	LPO 3065 - 62985
92	Blundells Swamp	LPO 3052 - 62986
101	Doyles Swamp	LPO 3065 - 62962
111	Pages Wharf Road	LPO 3057 - 62917
124	Near Pacific Park	WIL 3076 - 62985
125	Halls Lagoon	WIL 3056 - 62881
127	West Little Cattai Creek	WIL 3060 - 62865
128 (a)	Broadwater Swamp	WIL 3080 - 62865, 3100 - 62857
128 (b)	Wheeny Lagoon	WIL 3072 - 62870
131	Sth. Cattai National Park	WIL 3053 - 62845
132	Reedy Swamp	WIL 3070 - 62840
133	O'Haras Creek	WIL 3102 - 62791
134	Longneck Lagoon	WIL 3042 - 62825
136	Pitt Town Lagoon	WIL 3010 - 62810

Wetlands not identified for Draft REP 20, 1994 but recorded in previous studies

Fig. 1 Reference	Wetland	1:25000 map ref.
A	Sth. of Skeleton Rocks	LPO 3042 - 62977
B	East Cambridge Reach	LPO 3052 - 62956
C	Lambs Creek	LPO 3057 - 62927
D	East Gloucester Reach	LPO 3031 - 62965
E	Nth junction Portland and Sackville Reaches	LPO 3045 - 62930
F	South-east Liverpool Reach	LPO 3050 - 62995
G	North-east junction Sussex and Cambridge Reaches	LPO 3050 - 62973
H	Near Pacific Park	WIL 3079 - 62900
I	Nth. end O'Briens Road	WIL 3054 - 62894
J	Nth. of Hope Farm Cattai National Park	WIL 3043 - 62866
K	Cattai National Park	WIL 3048 - 62852
L	Cattai national Park	WIL 3043 - 62846
M	Kings Swamp Cattai National Park	WIL 3050 - 62867
N	Eastern wetlands Cattai national Park	WIL 3056 - 62851
O	Cattai National Park	WIL 3044 - 62853
P	Long Swamp	WIL 3088 - 62814
Q	Nth. of Long Swamp	WIL 3088 - 62827
R	Nth. end Cheesemans Road	WIL 3066 - 62889

Wetlands identified in Cattai CMC Study but not recorded in previous studies

Fig. 1 Reference	Wetland	1:25000 map ref.
S	Nth. Sussex Reach	LPO 3034 - 62962
T	Nth Pacific Park	WIL 3077 - 62908
U	South-west Leetsvale Caravan Park	WIL 3090 - 62987
SF1	West of "The Vale" Maroota Crown Land	WIL 3131 - 62907
SF2	Blue Gum Gully, Little Cattai Creek	WIL 3122 - 62907
SF3	North-south along Little Cattai Creek	WIL 3122 - 62868
HS1	Maroota Sand Swamp Forest	LPO 3132 - 62956
HS2	Green Rd/Rosebery Rd Hanging Swamp	RIV 3127 - 62685

Key to Wetlands of the Cattai Catchment

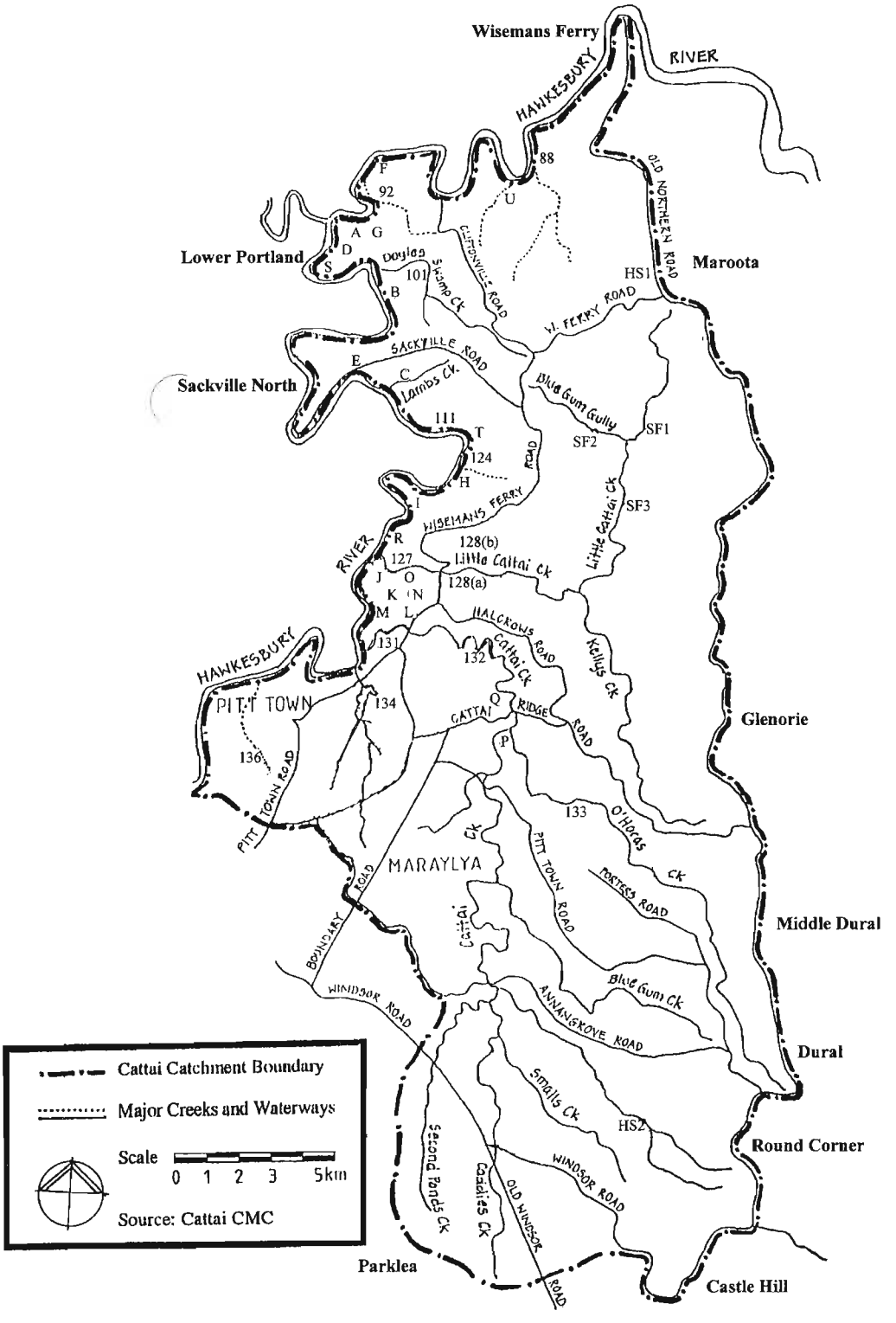


Figure 2. Locations of Wetlands identified in Cattai Catchment Wetlands Study

2 Literature Review of Cattai Wetlands - H. Latham 1996

The Latham report collates and reviews existing literature on the wetlands of the Hawkesbury-Nepean and in particular, the Cattai Catchment (see Figure 2). Wetlands are defined, the different types classified, and their distribution, boundaries, functions and values described; typical threats to wetland ecosystems within the region are discussed.

Wetlands are areas with characteristics of both terrestrial and aquatic environments and may contain fresh, brackish or saline waters that are static or flowing. Their soils are saturated permanently, seasonally or tidally by surface or groundwater typically to a depth of up to 2m. Saturation occurs at a frequency and duration sufficient to support distinctive aquatic or other wetland plants and fauna which differ from those in surrounding drier areas. Ephemeral wetlands can be relatively dry for long periods, while others may have little or no open water[1].

There are many types of wetlands adapted to a wide range of climatic and hydrological conditions and representing great diversity in structure, function and habitat. Wetlands occur along the coast, on inland riverine floodplains, and in arid and alpine areas. They include various swamps, floodplain woodlands and forests, billabongs, flood channels or depressions, peat bogs, sedgelands, mangrove swamps, salt marshes and tidal mudflats, sea-grass beds, fresh or brackish wet meadows, shallow lakes and lagoons, estuaries and claypans[2].

A wetland boundary, as the interface between land and water, and in the absence of clearly defined banks or shores, can be difficult to determine. It may vary seasonally and over time to change a wetland's relative size thereby altering the habitat for flora and fauna. The shallow margin of a wetland may be botanically determined by where the 'wetland indicator' plants are replaced by dry land species. Most Australian wetlands are classified on the basis of climate, geomorphology, vegetation structure and floristics, and hydrology (water salinity, depth and permanence). Most schemes employ a mixture of these criteria, the choice depending on the scale and purpose of the study[3].

Wetlands perform many valuable functions. These can be broadly classified as physiological, ecological, cultural and economic. Table 1 provides a list of these functions and their main components.

Table 1: Wetland functions and values

Functions and Values	Main Components
Physiological Functions	• Hydrologic regulation and erosion control • Geochemical storage • Water filtering and nutrient recycling
Ecological Functions	• Local microclimatic stabilisation • Flora and fauna habitat • Breeding and nursery areas
Cultural Values	• Visual amenity • Aboriginal cultural significance • Non-Aboriginal cultural significance • Recreation • Environmental research and education • Nature conservation
Economic Values	• Resource use and economics

Over half of Australia's wetlands have vanished since European settlement and those that remain are under increasing pressure from land and water development and from poor catchment management practices[4]. Table 2 lists the major direct and indirect threats to wetland functions and values.

Table 2: Typical threats to wetland functions and values

Direct Threats	Indirect Threats
• Hydrologic alteration	• Erosion and sedimentation
• Vegetation clearance	• Salinisation
• Agriculture	• Pollution
• Grazing	• Nutrient enrichment and eutrophication
• Burning	• Climate change
• Extractive industries	• Inappropriate landuse zoning
• Dredging	• Poor catchment management
• Urban development	• Lack of knowledge
• Inappropriate recreational activities	• Community attitudes
• Weed invasion	
• Introduced animals	
• Invasion by pathogens	
• Insect control measures	

Hawkesbury-Nepean Floodplain Wetlands

The Hawkesbury-Nepean floodplain wetlands were formed by a variety of fluvial processes where natural levee banks built up along the river tributaries cutting off low-lying back-swamps between the levee and the outer edge of the floodplain[5]. The wetlands vary widely in size and water regime and range from seasonal wet meadows along floodways and backchannels of the river, to semi-permanent water bodies (inundated for most of the year), to permanent open water lagoons.

Flora

A total of 130 species of native wetland plants (excluding algae) has so far been recorded in the Hawkesbury-Nepean River valley indicating a rich flora and diverse range of wetland types. There are many other native plant species on the fringes of wetlands that are not strictly wetland plants but grow in association with them. The recorded wetland plants include 15 species of particular conservation significance, comprising two of national significance and 13 of regional significance[6]. River-flat forests and swamp forests are also part of the wetland systems; they are rare and vulnerable with less than 1% of their original area remaining and little of this secured in conservation reserves[7].

Fauna

Floodplain wetlands are important habitats for aquatic fauna. When floodplains are inundated nutrients are released and plankton develop, fish spawn and larval success increases. The recharge and flushing of wetland systems allows increased movement of fish in and out of wetlands[8]. The most populous and diverse faunal group in wetlands are invertebrates (e.g., worms, snails, beetles, dragon flies and crustaceans). Little information is available on the catchment's fish species as numbers and species are likely to vary between individual wetlands according to a number of factors, including; water regime, seasonality and the density of macrophyte vegetation[9]. Frogs primarily use the margins of freshwater wetlands. Two threatened frog species found in the Cattai Catchment are the Red-crowned Toadlet (*Pseudophryne australis*) and the endangered Green and Golden Bell Frog (*Litoria aurea*)[10]. The Red-crowned Toadlet is restricted to Hawkesbury sandstone habitats, while the Green and Golden Bell Frog used to inhabit Pitt Town Lagoon, but has not been recorded there for many years[11]. Several species of snakes and lizards frequent the catchment's wetlands. The semi-aquatic and arboreal lizard, the Eastern Water Dragon (*Physiognathus leseurii*) is common throughout the region and has been recorded along Cattai Creek and the Hawkesbury River at Cattai National Park. The freshwater Long-necked Tortoise (*Chelodina longicollis*) is still relatively common in permanent and semi-permanent wetlands.

As the interface between terrestrial and aquatic environments, wetlands also provide food and water for many land-based animal species which may use them for all or part of their life cycles, or come to feed on the resident species. Wetland-using fauna groups (other than birds) are not well known and require further research to determine their status and relationship with the floodplain wetlands[12].

A total of 96 native water bird species have been recorded in the Hawkesbury-Nepean floodplain wetlands, including 34 species of particular conservation significance[13]. Both terrestrial and water bird species recorded in the Cattai wetlands are listed in descriptions of individual wetlands in the full report.

Usage, condition and significance

Due to extensive agricultural development (clearing and cultivation) on the Hawkesbury-Nepean floodplains, freshwater wetlands often contain the only substantial remaining native plant communities. Many of these however have been highly modified by nearly 200 years of drainage, clearing, filling, cultivation and grazing[14]. Benson and Howell[15] estimated that some 82% of the original area of fresh water wetlands in the County of Cumberland have been lost or degraded since European settlement. However, the Hawkesbury-Nepean floodplain wetlands still cumulatively support a rich native wetland flora and fauna. They have particular importance to water birds as a dependable drought refuge of state and national significance and as a wintering ground for a number of international migrants.

Cattai Catchment Wetlands

Most wetlands in the Cattai Catchment are riverine alluvial floodplain swamps or lagoons, of which there are approximately 30 to 50, although about half are either less than a quarter of a hectare in area or are under cultivation[16]. They are mostly fresh water (which tend to be more floristically diverse than saline wetlands), generally located less than 60 m above sea level, and mostly in rural settings. Some brackish wetlands occur between Sackville and Wisemans Ferry. They probably once supported swamp forest but have been largely cleared for agriculture[17]. It is likely that most of the low-lying valleys and lower reaches of the river's major tributaries supported extensive wetland areas before European settlement[18], and that many of the deep gullies supported swamp forests before logging.

The full literature report provides detailed information on thirty eight wetlands located within the Cattai Catchment. Fifteen of these are identified as regionally significant wetlands in the draft Sydney Regional Environmental Plan No. 20 - Hawkesbury-Nepean River (SREP 20 - 1996). Thirty two of the wetlands have been described and mapped in previous studies. Information provided in the full report includes: the wetland mapping number; Central Mapping Authority map reference; name; location; local government area; landuse zoning; ownership/management responsibility; wetland type; size; surface geology; vegetation; fauna; catchment characteristics; disturbance; and additional comments. Figure 2 shows the locations of the wetlands described in the full report, including the SREP 20 wetlands.

Previous research relating to the Cattai Catchment wetlands

A number of research studies have been undertaken on the wetlands in the Cattai CMC area and these are summarised below.

Goodrick[19] undertook a two year survey to map the wetlands of importance to waterfowl in coastal areas of New South Wales. Fourteen wetland types were described, eleven of which occur along the Hawkesbury-Nepean River and seven of which were in the Cattai Catchment. Goodrick concluded that by 1970 about 60% of the high-value waterfowl habitat previously available in coastal NSW had been destroyed or devalued for waterfowl, mostly due to drainage for flood mitigation. He cautioned that with increasingly intensive land usage, available habitat would continue to decrease and that to ensure effective waterfowl conservation important remaining wetland areas should be conserved, some

drained wetlands be rehabilitated, and substantial areas of land be managed primarily for waterfowl. The wetlands studied within the Cattai CMC area included Broadwater Swamp, Longneck Lagoon and Pitt Town Lagoon.

Benson[20] gathered data to produce a map of the original floodplain vegetation of the Hawkesbury-Nepean River system. Twelve vegetation types were described and mapped, five of which represented wetland vegetation. Benson concluded that many of the original freshwater swamps had been totally or partially drained for improved pasture, while the mangrove vegetation was relatively undisturbed.

Pressey[21] obtained data on eighteen wetland sites, seven of which were from the Cattai Catchment area. Pressey stated that the wetlands of the Upper Hawkesbury River are a very significant natural, scientific, educational and recreational resource. He considered that these wetlands should be given high priority for conservation and for management procedures which could increase their value to wildlife. He concluded that their long-term existence would only be possible with the input of money and energy for active management.

Moss[22] studied the wetlands of the Hawkesbury River. Nineteen of these were freshwater Cattai Catchment wetlands. Each wetland was numbered on maps and briefly described in the report, on the basis of wetland type and location, catchment characteristics, dominant flora and value to water birds. General comments were made about seasonal variability and how incremental impacts affect wetland condition. Accelerating siltation was identified as the most significant threat, followed by flood mitigation measures which were altering the natural water regimes of some wetlands.

The Royal Botanic Gardens Ecology Section[23] conducted a study of the conservation value of the natural vegetation along the Hawkesbury-Nepean River. The study area included the foreshores, wetlands (including those on the floodplain) and escarpment areas of the Hawkesbury-Nepean River from Pheasants Nest near Douglas Park downstream to Juno Point in Broken Bay, and the alluvial flats of the tributary Macdonald and Colo Rivers and Mangrove Creek. Wetlands of high conservation value were plotted on a series of 1:25,000 overlay maps. These maps formed the basis of the wetland protection clause in the Sydney Regional Environmental Plan No. 20 (1989). Twenty-three Cattai Catchment wetlands were described. Conservation values were based essentially on vegetation extent, condition and composition.

The Shortland Wetlands Centre[24] conducted a study on wetlands in New South Wales, twenty-two of which came from the Cattai Catchment area. The authors noted that without a major shift in government policies many more of the wetlands would be either lost or would no longer fit wetland definition criteria.

Stricker & Wall[25] conducted a study of the wetlands of the Hawkesbury-Nepean Catchment. This study was conducted to clarify the distribution and characteristics of the Hawkesbury-Nepean catchment's wetlands and to provide a regional information base for strategic water cycle and catchment management - in particular, for the management of water resources in the river system by the Sydney Water Board and other relevant agencies. The report highlighted the need for more detailed research on wetlands as important ecosystems.

Benson & Howell[26] conducted a study that described the original vegetation of the Hawkesbury-Nepean River before European settlement, the changes upon it since 1788, the current extent and status of the remaining riparian vegetation, and a strategy for guiding its rehabilitation and protection. While 'riparian' vegetation is technically associated with the immediate banks of the river, this study included the river's alluvial floodplain and associated wetlands. Remnant wetlands were noted to vary considerably in terms of floristic composition, drainage and flooding conditions. Changes in vegetation dynamics were considered in terms of declining populations of native species, competition from exotic weeds and pasture grasses, flood effects, wetland drainage and sand extraction.

Stricker & Adam[27] gave a fairly detailed description of wetland types in the Sydney Region. General comments were made about Hawkesbury-Nepean floodplain wetlands. Fourteen freshwater Cattai Catchment wetlands were recorded. Also included was a discussion of the functions and values of wetlands and the causes of wetland degradation and loss. They noted Australia's international responsibility for wetland conservation, but concluded that Sydney's 'green arc' of National Parks and Nature Reserves did not adequately conserve floodplain wetlands and excluded most of the estuarine and brackish types.

A study conducted by P&J Smith Ecological Consultants[28] surveyed the wetlands of the Hawkesbury-Nepean River valley as part of a review of the wetland protection clause in Sydney Draft Regional Environment Plan No. 20 (1996). The aim of this study was to improve the identification and protection of significant wetlands in the Sydney Region in REP 20's 1994 Draft Amendment. A total of 159 significant wetlands were identified and mapped with boundaries defined for statutory planning purposes and a clear distinction was made between permanent and ephemeral areas. These were described in tabular form and included 14 in the Cattai Catchment.

Skelton[29] assessed 16 wetlands in the Hawkesbury-Nepean catchment including four in Cattai Catchment. Tabulated information covers factors such as location and access, owner contact, wetland disturbance, and adjacent catchment landuses; wetland size, depth, substrate and water quality; percentage cover of floating, attached, emergent, submergent, native and exotic plant species; detailed plant species lists and brief notes on fauna. The survey provided the basis for the development of rapid assessment protocols for freshwater wetlands and saltmarsh vegetation to facilitate monitoring of the 'health' (condition) of wetlands by both professional and lay persons.

A set of reports is being prepared for the National Parks and Wildlife Service (NPWS) which includes information on the Aboriginal and European history of Cattai National Park (including Mitchell Park), Aboriginal sites, geology and soil landscapes, plant and faunal species lists, habitat assessment, visual quality assessment of the various landscape components, an appraisal of landuse conflicts, statement of significance, and management options and guidelines. It includes four of the Cattai Catchment wetlands[30].

Conclusions

The review of literature clearly indicates the variety of wetlands occurring within the Cattai Catchment and the great value of these wetlands for conservation of wildlife and the ecological services they provide. Fieldwork and this review of available literature suggest that the major threats to wetlands in the Cattai Catchment are: altered water levels and drainage patterns; vegetation clearance; agriculture; grazing (cattle and horses); weed invasion; filling; inappropriate recreational activities (e.g., motorbikes); activities beyond a wetland's local catchment such as residential development and road construction on surrounding slopes and ridges, turbidity and sedimentation from sand extraction, and nutrient enrichment from agricultural and grazing practices; introduced animals (particularly European carp); and lack of understanding about wetland values and management.

In order to conserve wetlands in the Cattai Catchment area these threats will need to be addressed and wherever possible reduced or prevented. The Australian Museum Business Services study, summarised next, considered in more detail the conservation values of four wetlands and how the threats to them could be managed.

3 Cattai Catchment Wetlands Project - Australian Museum Business Services 1996

This study aimed to compare and contrast the flora, fauna and habitat quality of four wetlands within the Cattai CMC area, selected to represent a range of different wetland types found within the catchment. These were Broadwater Swamp, Blundells Swamp, Long Swamp and Pitt Town Lagoon. The locations of these wetlands is shown in Figure 2 - Introduction. Of the four wetlands, Long Swamp is the only one not included as a mapped wetland in Sydney Regional Environment Plan No. 20 - Hawkesbury-Nepean River.

Previous biological studies of wetlands within this catchment area have focused only on vegetation and waterbirds; little specific information existed about such fauna as fish, frogs, reptiles and macroinvertebrates. One of the principle aims of this study, therefore, was to identify animal species, including mammals, reptiles, amphibians, fish and macroinvertebrates, both native and introduced, that are known or likely to use the wetlands.

The study was undertaken in three stages:

1: aerial photography, database searches and literature review

2: field surveys involving fauna and flora surveys, water quality testing and habitat assessment. Each site was photographed to help provide a record of the condition of the wetland and the habitats sampled. The wetlands were classified at each site according to the system of P&J Smith Ecological Consultants[31], as shown in Table 3. Areas adjacent to the wetlands were not surveyed.

3: final report which includes data assessment, a discussion of the conservation values and of the management needs for protection and enhancement of these and other wetlands within the Cattai Catchment.

Table 3: Wetland vegetation classification

Wetland type	Structure	Main species
Tree Swamp	Well-developed tree layer, with understorey dominated by wetland plants (as described by Sainty and Jacobs,1981.)	Snow-in-Summer, occasionally Swamp Mahogany and Cabbage Gum.
Shrub Swamp	Well-developed shrub layer, with understorey dominated by wetland plants.	Mainly Swamp Paperbark.
Open Herb Swamp	Wetland dominated by open water - limited emergent vegetation, floating or submerged plants may be extensive.	Herbaceous plant species.
Dense Herb Swamp	Dense growth of herbaceous wetland plants.	Common Reed, Tall Spike Rush, Cumbungi, Bull-rush, Club-rush, March Club-rush, River Club-rush, Water Couch, Water Ribbons, Water Primrose and Woolly Frogmouth.
Ephemeral Herb Swamp (Flooding less frequent than in dense herb swamp)	Dense growth of herbaceous wetland plants.	Common Rush, Water Pepper and Knotweed, Tussock Sedge, Common Couch, Slender Mudgrass and Blackseed Panic.

Long Swamp

Long Swamp occurs on the western edge of the Hornsby Plateau within the hilly terrain which characterises the Hawkesbury Sandstone landscape. This swamp has a well vegetated catchment with large areas of native forest vegetation remaining intact and is connected to the Hawkesbury River via streams except in times of drought (Figures 3 and 4).

Figure 3. Aerial photo of Long Swamp

Long Swamp is a relatively small freshwater wetland area, approximately 3.2 ha in size[32]. It is a flooded portion of O'Haras Creek, at the junction of O'Haras Creek with Cattai Creek. It possesses a channel which is more than 1.5 metres deep in parts and has an almost indiscernible rate of flow with a low but regular discharge into Cattai Creek. In appearance Long Swamp is a natural wetland. There may, however, have been artificial alteration to the flow of O'Haras Creek.

The southern side of Long Swamp consists of a wide floodplain that has been cleared of most of the original tree cover, apart from remnants along the swamp and creek banks. More intact dry sclerophyll forest remains on the northern side on a steep sandstone slope. The cleared portions adjacent to the wetland appear to be disused pasture, where various herbaceous weed species are well-established. The steep-sided nature of the banks of the swamp precludes the development of an extensive margin of fringing vegetation adjacent to the swamp.

The current zoning of Long Swamp is Rural 1(b). The main land uses in the catchment of the wetland include agricultural activities such as grazing. Sand extraction and clean filling is also carried out upstream of Long Swamp.

Figure 4. Long Swamp

Species richness, for both flora and fauna, is relatively high for Long Swamp. Clearing of vegetation along the swamp edges has resulted in a reduction in the availability of animal habitats, particularly those requiring fallen logs. Weed invasion of the riparian vegetation, particularly by Privet (Ligustrum sinense), degrades the wetland to a certain extent. Long Swamp was assessed as not being a significant wetland by P&J Smith Ecological Consultants[33], nor by other studies of the Hawkesbury-Nepean wetlands.

Broadwater Swamp

Broadwater Swamp occurs at the northern edge of the Cumberland Plain and extends into the hilly terrain which characterises the Hawkesbury Sandstone landscape (Figure 5). This swamp has a well vegetated catchment with large areas of native forest remaining intact and is connected to the Hawkesbury River via Little Cattai Creek (Figure 6).

Figure 5. Aerial photo of Broadwater Swamp

Broadwater Swamp is an extensive natural wetland, although some artificial alteration has been carried out. For example, diversion drains have been constructed in some sections of the valley floor to create flat grazing land. Adjacent to the swamp are narrow strips of floodplain grassland. In many parts of the adjoining land the original dry sclerophyll forest vegetation remains, although where broad flats occur the forest has been partially cleared and grassland encouraged.

Relatively few species of aquatic and riparian plants, including introduced species, are established. Broadwater Swamp consists of an open herb swamp whose vegetation is dominated by herbaceous wetland species and large areas of open water with limited emergent vegetation. There is, however, moderate abundance of surface-floating attached native vegetation.

At the time of sampling, the waters of the swamp had relatively high turbidity, precluding the growth of submerged vegetation. Livestock may have been responsible for long term reduction in native woody vegetation, particularly through the trampling of young regrowth. However, the vegetation adjacent to the water body forms a rich and productive habitat for a variety of fauna. One bird species, Latham's Snipe, previously recorded at Broadwater Swamp is listed on both the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA). Broadwater Swamp is listed as a SREP 20 wetland and stated as having significant vegetation and water bird values. The current zoning of the eastern end of Broadwater Swamp is Environmental Protection 7(a) (Wetlands) whilst the remainder of the wetland is currently zoned Rural 1(b).

Figure 6. Broadwater Swamp

Blundells Swamp

Blundells Swamp occurs further north of the Broadwater Swamp, well within the Hawkesbury Sandstone landscape. It is an elongated, shallow natural wetland situated in a narrow valley fed by small streams. The slopes of the valley are steep and forested. The swamp is dominated by dense stands of sedges and submerged vegetation, and fringed in parts by tree swamp (Figures 7 and 8). It currently has no connecting stream channel to the Hawkesbury River.

Blundells Swamp may in the past have been connected to the Hawkesbury River. It has previously been drained for the purpose of building a road. Two levee banks appear to have been constructed in the wetland. In addition, a road embankment exists at the western end of the wetland, approximately 50m from the Hawkesbury River. Part of the valley floor, on the southern side of the swamp, has been cleared for agricultural purposes. Despite these alterations, Stricker and Adam[34] state that there has been no effective disturbance to the functioning of the wetland. Areas upstream of Blundells Swamp appear not to have been greatly impacted by agriculture, clearing and previous sand and soil extraction.

In recent years a levee bank has been constructed to reinstate the wetland. The long term effects of this levee bank on the wetland need to be established.

Figure 7. Aerial photo of Blundells Swamp

Water quality measurements at Blundells Swamp revealed low pH values (3.6 - 3.9). These may be the result of breakdown of tannins in riparian eucalypt vegetation and/or from the exposure of acid-sulphate soils resulting from past earthworks. These low pH values may account for the absence of fish. Macroinvertebrates however were well represented.

Blundells Swamp is included as a SREP 20 wetland; studies have shown the area to hold significant vegetation and water bird values and generally have high conservation values. The current zoning of Blundells Swamp is Rural 1(b). However, under the NSW National Parks and Wildlife Act 1974, this wetland is a dedicated Wildlife Refuge.

Figure 8. Blundells Swamp

Pitt Town Lagoon

Pitt Town Lagoon is located on the Hawkesbury - Nepean floodplain. It is a natural, freshwater lagoon which lies in a discrete drainage basin not far from the Hawkesbury River (Figures 9 and 10). It has no permanent connection to the river. The lagoon is a highly altered, eutrophic swamp, surrounded by agricultural and urban development. Its local catchment is small and is confined by the adjacent low ridge where the township of Pitt Town is situated. During floods the lagoon receives overflows from the river, but is known to dry up completely during drought.

Pitt Town Lagoon has been severely impacted by land uses within its catchment. Livestock grazing in the past has altered the vegetation occurring in this wetland. Furthermore, the invasion of introduced weed species is relatively high, particularly on the margins of the wetland. In addition, relatively poor water quality was recorded during the study and no fish were observed.

At the time the survey was undertaken most of Pitt Town Lagoon consisted of open water with limited emergent vegetation, and an extensive cover of dead vegetation. There is, however, extensive growth of floating plant species, both native and introduced. Pitt Town Lagoon also possesses an extensive ephemeral herb swamp whose vegetation is dominated by both introduced and native species, and a smaller area of dense herb swamp. The outermost margin of the lagoon is severely degraded by introduced species.

Pitt Town Lagoon forms part of Pitt Town Nature Reserve and is zoned Nature Reserve 8(a). To the north-west of the lagoon is the township of Pitt Town. The area to the south-east is zoned Rural 1(c), whilst most of the remainder of the surrounding area is zoned Environmental Protection (Scenic) 7(d1).

Figure 9. Aerial photo of Pitt Town Lagoon

Figure 10. Pitt Town Lagoon

Conservation significance of the study sites

A comparative assessment of the conservation significance of the four wetlands is given in Table 4. This shows that each of the wetlands has, for this study, been assessed as having conservation value.

Table 4: Assessment of the conservation significance of the four wetlands

Wetland / Criteria	Long Swamp	Broadwater Swamp	Blundells Swamp	Pitt Town Swamp
Native plant species richness	high	moderate	low to moderate	low to moderate
Exotic species invasion (riparian vegetation)	moderate to high	low	low	moderate to high
Exotic species invasion (aquatic vegetation)	low	low	low	low
Habitat diversity	high	high	high	low to moderate
Degree of disturbance, e.g. by land use within catchment	moderate	low	low	moderate to high
Water quality	moderate to high	moderate to high	high	low
Aquatic macro-invertebrate richness	moderate	moderate	high	low
Fish species richness	high	high	nil	nil
Frog habitat quality	moderate	moderate	high	low to moderate
Wetland bird habitat quality	moderate	moderate	moderate	high
Reptile habitat quality	moderate	moderate to high	moderate to high	low
Native animal species richness †	high	high	moderate	moderate
Threatened wetland plant species	none	one	none	none
Records of Threatened fauna species †*	none	three	one	six, including five waterbird species
Assessment of significance †	high	high	high	high

† Based on database search and literature review

* This is the only criterion not to be based on field surveys

Management Considerations

For a wetland to function naturally it is important to ensure that the water quality and hydrology have not been altered, that sedimentation and erosion are minimised and that introduced species of plants and animals are controlled. A naturally functioning wetland is vital for maintaining diverse plant communities which can support a range of animal species (from birds and fish to invertebrates), including internationally important waterbirds. It is important to consider the effects of activities in the Cattai Catchment. Raising awareness and cooperation with landholders is fundamental to ensuring the natural functioning of a wetland.

Current threatening processes identified during this study include grazing, sand-mining, nutrient enrichment and introduced species. One or more of these threats is operating, to varying degrees, at each of the wetlands in the pilot study.

The impact of past grazing activity is particularly evident at Pitt Town Lagoon, where a high number of introduced plant species, mostly agricultural weeds, dominate the margin of the lagoon. Grazing has also probably contributed to the spread of introduced plant species in the riparian vegetation of Long Swamp, as well as patchy zonation of vegetation adjacent to the wetland. Grazing appears to have impacted less at Broadwater Swamp (possibly because livestock concentration is lower) and at Blundells Swamp.

Threats resulting from introduced plant species are of particular concern at Long Swamp which has been infested with introduced mosquito fish (*Gambusia holbrooki*) and where Privet (*Ligustrum sinense*), Poplar (*Populus* sp.) and Blackberry (*Rubus fruticosus*) are invading, and in parts dominating the riparian vegetation. The outer margins of Pitt Town Lagoon are likewise under threat from introduced species such as Spear Thistle (*Cirsium vulgare*) and Purpletop (*Verbena bonariensis*).

Nutrient enrichment is a concern at Pitt Town Lagoon, which receives runoff from surrounding agricultural and urban settlement. Such an impact is also of concern at Broadwater Swamp and to a lesser degree Long Swamp, where grazing and pasture improvement is carried out within their catchments.

Long Swamp, with its comparatively high turbidity levels and lack of submerged vegetation, may be suffering from the impact of sand quarrying upstream. Such industries have the potential to significantly impact upon wetlands by increasing or decreasing sediment load. This increases turbidity, thereby suppressing the growth of submerged vegetation. In addition, increased sedimentation may also lead to the eventual filling of the wetland. Reductions in submerged vegetation reduce shelter and food resources for macroinvertebrates, with consequent reductions in prey for fish, frogs and birds.

Removal of fallen timber from around wetlands is likely to reduce shelter for reptiles and amphibians and is therefore considered a threatening process. It is unknown to what extent this has occurred around the four wetlands.

4 Oral History Report: Interviews with wetland landholders - P. Schwartz 1996

The four wetlands selected for this study were the same as those investigated by the Australian Museum Business Services. The information from the interviews has been summarised and combined to give an idea of the history of each wetlands' use. In the case of Pitt Town Lagoon landowners adjacent to the wetland were interviewed as the wetland is a Nature Reserve under the control of the National Parks and Wildlife Service.

Long Swamp

The land was originally cleared for grazing but watermelons and other crops have also been grown. During the 1970's a riding school was established and a soil extraction business was set up. The original slab huts existed until relatively recently and until the early 80's a slab hut and old fencing remained on one property. Grazing of Long Swamp continues today.

Broadwater Swamp

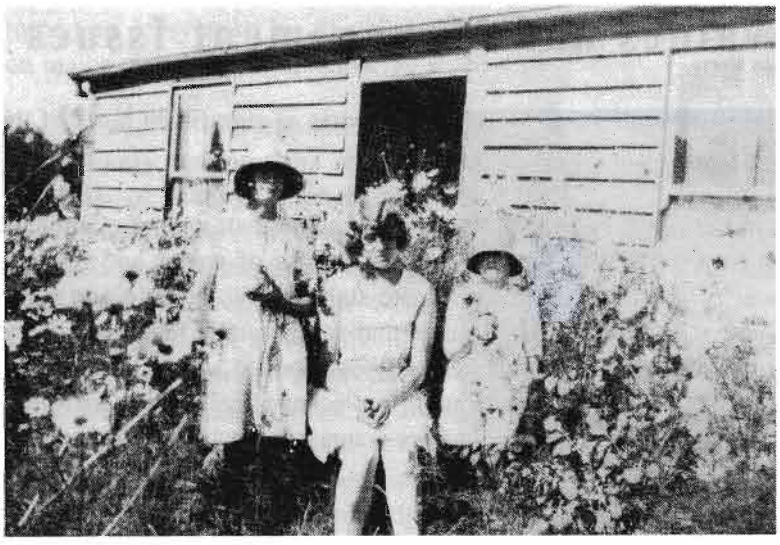
The first survey (1832-1834) in the area was by Felton Matthew. His wife kept a diary of her observations in the area in the 1830's. The main surveys around Little Cattai Creek were carried out in the 1880's. Some of the early settlers names were Fairs, Johnston, McGregor, Edwards, Hall, Smallwood and Miller. Typical produce consisted of peaches, pears, oranges, honey, corn and pigs. Prior to 1860, Joe Fairs had an orchard and blacksmiths shop on the Broadwater. Around this time there were seventeen houses in the area. Farm products were sent down Little Cattai Creek to the Hawkesbury River and timber was brought down the creek to the sawmill at Cattai. Soil was mined about 50 years ago and the A.G. L. pipeline was installed around 1983-5. Cattle grazing has taken place on the Broadwater up to the present day.

Blundells Swamp

In 1915 John Blundell and his family moved from the Colo to occupy the Blundell Swamp area. He and his three sons worked the farm producing corn, watermelon, cauliflower, cabbage, broccoli, potatoes and other vegetables towards the back of the valley. Stonefruit trees were planted on the hillsides and cattle grazed the swamp area. The transport of produce was initially by boat. The swamp was initially drained for agriculture. The drains were later abandoned. However, the drainage channels used on the property can still be seen. During the most productive years of the farm, three and a half semi-trailer loads of produce were sent to the market each week. John Blundell's homestead "Ferndale" still exists. In recent years leisure pursuits and passive appreciation of the area have largely replaced farming although there has also been some soil extraction.

Pitt Town Lagoon

Pitt Town Lagoon was part of the Pitt Town Common (the wet common), which was granted to the people of Pitt Town for keeping their milking cows, working horses and sulky horses. The Common was managed by a Trust which ensured that there was no misuse of the Common and that it was kept in good condition. It was seen and used as a community asset and the fees charged for stock grazing were used for maintaining the Common. Trustee positions were sometimes held by members of the same family for up to three generations. In 1972 the National Parks and Wildlife Services took over management of the lagoon.



From left: Ivy, Amy and Ruby Weaver in the garden at "Landsdale".

His hands and his hoe are his helpers. Joe digging potatoes.

Ready for roadwork. Joshua Weaver with horses and dray. "Darkie" (in shafts) with "Lucy" in tow, are the horses.

Figure 11. Photos from the 1930's of life around the Maroota area. From "Life at Landsdale", Ruby E Ramm - Mountain Press

5 Conservation Values and Management Issues

The wetlands of Cattai Catchment have been identified in all three reports as significant parts of the wetland resources in the Hawkesbury-Nepean Catchment.

The wetlands play an important part in the control of water flows, in the natural storage of chemicals, in nutrient filtering and recycling, in trapping sediments, in the slow release of water, and in flood mitigation. Their ecological benefits also include local microclimate stabilisation, aquatic and semi-aquatic flora habitat, breeding and nursery areas for larger aquatic and semi-aquatic fauna, as a food and water resource for terrestrial animals and as habitat for the easily overlooked aquatic macro- and micro- flora and fauna. Wetlands have also been identified as important economically for their role as a resource in fish breeding, for tourism, as permanent and temporary water storage and for their role in erosion control and nutrient polishing.

Culturally these wetlands have been identified as valuable for their visual amenity, their Aboriginal and European significance, as sources of recreation, as resources for environmental education and research, and for nature conservation in preserving a small part of the Hawkesbury's natural history. Those people that are fortunate enough to live and work on and around wetlands value them for the contribution to their lifestyle and quality of life.

In the 209 years since European occupation there has been a dramatic increase in disturbance to the wetlands leaving only 20% of what was once in the Hawkesbury/Nepean catchment. Those wetlands that have survived have generally done so despite major disturbances and now require careful management.

Table 5 provides a list of management issues identified in the three reports that need to be taken into account to ensure the adequate conservation, management and protection of the wetlands in the Cattai Catchment environment.

Table 5: Management issues for the wetland environment

MANAGEMENT ISSUES	
• Clearing	• Grazing
• Weed invasion	• Introduced terrestrial animals
• Introduced aquatic animals	• Levee bank, damming, flooding
• Perimeter road/track	• Channelling draining/extracting water
• Grading/bulldozing	• Dumping
• Sediments/siltation	• Extractive industry
• Residential/commercial development	• Industrial development
• Salinity	• Water turbidity
• Nutrients/eutrophication	• Recreation
• Fencing	• Utilities
• Bushfire	• Social/cultural/economic

The 38 identified wetlands in Cattai CMC area are an essential resource for the whole Hawkesbury-Nepean catchment. They vary enormously in the amount of disturbance that has impacted on them, in their current state of health and in the recovery they have made since disturbance. Some wetlands are relatively pristine, some have rehabilitated extremely well and others are in need of enormous efforts to ensure they retain their function and value as a wetland.

The durability of wetlands also needs to be respected and much care must be taken in determining the best management plan for each wetland. The studies show that no two wetlands are alike. Each wetland has to be treated as the individual and very complex ecosystem that it is. Further on-ground study will be necessary for the establishment of management plans for each wetland and the continued involvement of the owners and stakeholders is essential. There is a great deal more to learn about these

important ecosystems by all stakeholders and the precautionary principle is advised before embarking on major management systems.

In the majority of wetlands it will more likely require the gradual removal of heavy impacts and careful monitoring of the reaction of the wetland. In some cases a helping hand may be needed with weed eradication and re-establishing riparian vegetation and macrophyte beds. We need to ensure that we are all educated and aware of the value of wetlands to our catchment and continually update our knowledge on management and rehabilitation methods aprrpropriate to welands within our catchment.

Above all we can be proud that so many significant and valuable wetlands remain in Cattai Catchment and that so many people have cared for and helped retain these magnificent ecosystems.

Figure 12. Impacts of in-stream extraction on O'Haras Creek near Long Swamp

Figure 13. Impacts of clearing and grazing on Wetland No 131 Cattai National Park

6 References

1. Adapted from Department of Water Resources (DWR) and Sydney Water Board (1990). *Issues in Wetland Management.* Paper based on Shortland Wetlands Centre (1988a, b). *Wetlands in New South Wales. Reports Nos. 1 & 2 - Sydney.* Unpublished reports to the Department of Water Resources and Sydney Water Board.
2. ibid.
3. Shortland Wetlands Centre (1988a). *Wetlands in New South Wales. Report No. 1 - Sydney.* Unpublished report to the Department of Water Resources and Sydney Water Board. Shortland Wetlands Centre, Newcastle, p.35.
4. Australian Nature Conservancy Agency (1993). *Australian Wetlands.* ANCA, Canberra.
5. Benson, D.H. & Howell, J. (1990a). *Taken for Granted: the Bushland of Sydney and its Suburbs.* Kangaroo Press in association with the Royal Botanic Gardens, Sydney, p.26.
6. P&J Smith Ecological Consultants (1994). *Significant Wetlands of the Hawkesbury-Nepean River Valley.* A study prepared for the NSW Department of Planning. DoP, Sydney, Appendices 3 & 4.
7. Fremanis, E. (1993). *Swallow Rock Reserve Vegetation Management Plan.* Greening Australia, Sydney.
8. Burchmore, J.J. (ed.) (1993). *Freshwater Habitat Management Guidelines.* NSW Fisheries, p.8.
9. Briggs, S.V. (n.d). Wetlands: An Introduction, in NPWS (ed) *Wetlands* NSW, p.5-9.
10. Stricker, J.S. & Wall, C.A. (1995). *Wetlands of the Nepean-Hawkesbury Catchment.* Sydney Water Board, Sydney.
11. Robertson, D. (1996). Australian Museum, personal communication 19.4.96.
12. Stricker, J.S. & Wall, C.A. (1995). *Wetlands of the Nepean-Hawkesbury Catchment.* Sydney Water Board, Sydney.
13. P&J Smith Ecological Consultants (1994). *Significant Wetlands of the Hawkesbury-Nepean River Valley.* A study prepared for the NSW Department of Planning. DoP, Sydney, Appendices 5 & 6.
14. Benson, D.H. & Howell, J. (1990b). Sydney's Vegetation 1788-1988: utilisation, degradation and rehabilitation. *Proceedings of the Ecological Society of Australia* 16, 115-127.
15. Benson, D.H. & Howell, J. (1993). *A Strategy for the Rehabilitation of the Riparian Vegetation of the Hawkesbury-Nepean River.* Royal Botanic Gardens, Sydney.
16. Stricker, J.S & Adam, P. (1993). *Wetlands of the Sydney region.* Unpublished report prepared by the Nature Conservation Council of NSW for the NSW Department of Planning.
17. Department of Planning (1989). *Sydney Regional Environmental Plan No. 20 Hawkesbury Nepean River.* DoP, Sydney.
18. Recher, H.F., Hutchings, P.H. & Rosen, S. (1993). The biota of the Hawkesbury-Nepean catchment. *Australian Zoologist,* 29(1-2), 3-41.
19. Goodrick G.N. (1970). *A Survey of Wetlands of Coastal New South Wales.* Technical Memorandum No. 5. CSIRO Division of Wildlife Research, Canberra.
20. Benson, D.H. (1974). Survey of the natural vegetation of the floodplain of the Hawkesbury River and its major tributaries. In Scholer (ed.) *Geomorphology of New South Wales Coastal Rivers, Report No. 139.* Water Research Laboratory, University of NSW, Sydney, p. 68-69.
21. Pressey R.L. (1979). *Waterbirds and Wetlands of the Upper Hawkesbury River.* Master of Environmental Studies Thesis, Macquarie University, Sydney.
22. Moss, J. (1979). *Hawkesbury River Wetlands Study.* Unpublished report to the State Pollution Control Commission, Sydney.
23. Royal Botanic Gardens (1986). *The Conservation Value of Natural Vegetation along the Hawkesbury-Nepean River.* Ecology Section, Royal Botanic Gardens, Sydney.
24. Shortland Wetlands Centre (1988b). *Wetlands in New South Wales. Report No. 2 - Sydney.* Unpublished report to the Department of Water Resources and Sydney Water Board. Shortland Wetlands Centre, Newcastle.
25. Stricker, J & Wall, C.A. (1995). *Wetlands of the Nepean-Hawkesbury Catchment.* Sydney Water Board, Sydney.
26. Benson, D.H. & Howell, J. (1993). *A Strategy for the Rehabilitation of the Riparian Vegetation of the Hawkesbury-Nepean River.* Royal Botanic Gardens, Sydney.
27. Stricker, J.S & Adam, P. (1993). *Wetlands of the Sydney Region.* Unpublished report prepared by the Nature Conservation Council of NSW for the NSW Department of Planning.
28. P&J Smith Ecological Consultants (1994). *Significant Wetlands of the Hawkesbury-Nepean River Valley.* A study prepared for the NSW Department of Planning. DoP, Sydney.
29. Skelton, N. (1995). Wetland assessment data for *Hawkesbury-Nepean Catchment.* Unpublished report to Hawkesbury-Nepean Catchment Management Trust, Windsor.
30. Clouston (1995). *Draft Cattai National Park Conservation Plan.* Prepared for the NSW NPWS.
31. P&J Smith Ecological Consultants (1994). *Significant Wetlands of the Hawkesbury-Nepean River Valley.* A study prepared for the NSW Department of Planning. DoP, Sydney.
32. Moss, J. (1979). *Hawkesbury River Wetlands Study.* Unpublished report to the State Pollution Control Commission, Sydney.
33. ibid.
34. Stricker, J.S. & Adam, P. (1993). *Wetlands of the Sydney Region.* Unpublished report prepared by the Nature Conservation Council of NSW for the NSW Department of Planning.

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